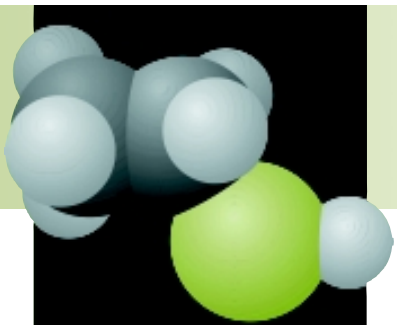
CHEMICALS

Project Fact Sheet



SONIC ASSISTED MEMBRANE

BENEFITS

- Reduces maintenance costs
- Increases the number of biological applications for membranes

APPLICATIONS

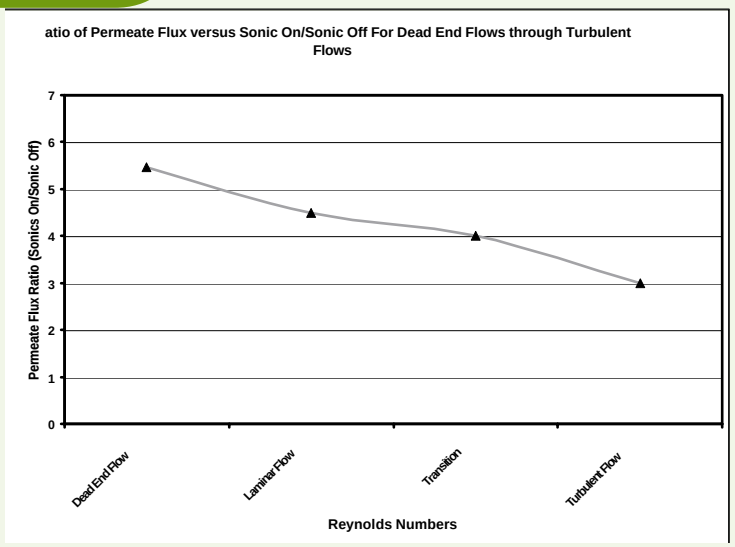
Sonic assisted ultrafiltration membranes can be used to remove and/or prevent build-up of foulants and can increase flux. This technology can be utilized in a several industries for a broad range of biological applications, including wastewater treatment, dye recovery, cell harvesting, feed water treatment, groundwater remediation, and desalination and water purification operations.

LOW FREQUENCY ACOUSTIC RESONATOR ADDRESSES MEMBRANE FOULING

In almost all ultrafiltration and microfiltration applications, the occurrance of a gel layer on the membrane surface results in significant reduction in flux below the intrinsic membrane water flux levels. 'Gel formation' is caused by a phenomena known as concentration polarization. The thickness of the gel layer becomes the controlling parameter for flux. Gel layer thickness is a function of the fluid velocity across the membrane surface. High cross flow velocity minimizes the gel layer but is energy intensive and the increased shear is undesirable in biological applications. This project will develop a sonic device that produces low frequency high intensity acoustic vibrations in elastic solids. These vibrations should induce micro turbulence in the fluid near the membrane surface and minimize gel layer formation.

The commercial viability of biotechnology processes is dependant on the efficiency of downstream operations that separate and recover the products. Membrane filtration systems are superior to centrifugation separation for biotechnology applications and are ideally suited to meeting the challenges imposed by biotechnology. One of the main impediments to broader use of membranes in biotechnology industries is the diminishing flux experienced by all micro and ultrafiltration membrane filters. Coupling a sonic device with membrane filtration offers a solution that is technologically simple and effective.

PERMEATE FLUX RATIO



Plot of 5 percent pepsin permeate flux ratio as a function of cross-flow for three different trans-membrane pressure differentials. Flows between 4 and 7 gallons per minute (gpm) have Reynolds Numbers in the transition flow regime. Flows below 4 gpm are laminar.

Project Description

Goal: The goal of this project is to couple ultrafiltration technology with a mechanically driven, high intensity, low frequency acoustic resonator to reduce membrane fouling in biochemical applications.

Progress and Milestones

Initial research accomplished the following objectives:

- Demonstrated improved flux in a representative membrane system. Permeate flux improvements were measured to be 2 to 3 times greater than conventional cross-flow filtering operations.
- Proved stability of the enzyme when subjected to the strong acoustic field generated by the sonic device.
- Demonstrated the durability of the ultrafiltration membrane in the acoustic field.

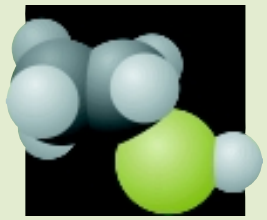
The specific objectives of current research include:

- Demonstrate that permeate mass flux through the sonic ultrafiltration is four times that of conventional cross-flow ultrafiltration methods.
- Demonstrate that the sonic ultrafiltration process is not detrimental to enzymes or production of product. This objective will be met when it is shown that 90 percent of the enzyme activity is sustained after 3 months exposure to the resonating acoustic field.

Establish a prototype sonic ultrafiltration advanced membrane reactor design, including sonic device, geometric configuration, materials, and operational conditions.

Commercialization

A prototype batch reactor is currently under development by Montec Research. This prototype is scheduled for delivery in 2002.



Project Partners

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February 2001